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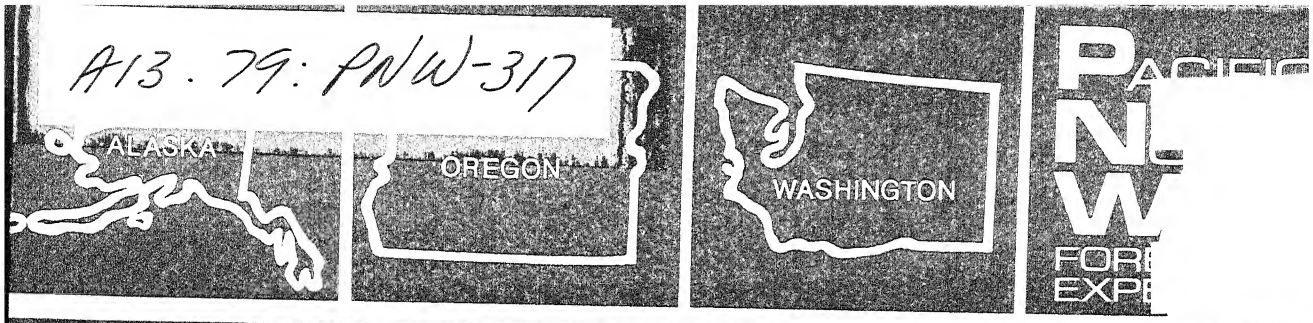

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August 1

ORIGIN AND DEVELOPMENT OF VEGETATION AFTER SPRAYING AND BURNING IN A COASTAL OREGON CLEARCUT

by

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Abstract

Numbers of brush resprouts and seedlings increased following spraying and burning on north and south aspects in one clearcut in the Oregon Coast Ranges. A release spray applied 3 years after burning reduced shrub but not herbaceous cover. The study suggests that good control of residual vegetation after logging and prompt reforestation are essential in brush-threat areas of the Coast Ranges.

KEYWORDS: Site preparation (-regeneration, revegetation, herbicides (-regeneration, fire use, succession, Oregon (Coast Ranges).

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife -- if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

FOREST SERVICE - U.S. DEPARTMENT OF AGRICULTURE - PORTLAND

INTRODUCTION

Conifer and mixed conifer-hardwood stands in the Oregon Coast Ranges often have a well-developed understory of shrub species such as salmonberry[1], vine maple, red huckleberry, and salal and herbs such as western springbeauty, bleeding heart, and swordfern that remain after logging. Dense shade cast by this ground cover prevents drying of logging slash and reduces effectiveness of broadcast burning (Williams 1964). Aerial spraying of herbicides prior to burning to reduce shade and increase the amount of fine fuels is rapidly becoming standard practice following clearcutting in the Coast Ranges.

Sprayed areas can often be burned under marginal conditions making fire control easier (Bentley et al. 1971, Carpenter et al. 1970, Green 1970). Desiccation of woody vegetation with herbicides markedly influences fire behavior--more than can be attributed to changes in fuel moisture content alone (Bentley et al. 1971). Fires in sprayed brush build up and spread over an area more rapidly and uniformly than do fires in unsprayed brush (fig. 1). If, however, weather conditions are not favorable for drying or if burning is done too soon after spraying even a spray that kills the brush cannot assure a good burn (Ryker 1966).

Much is known about the influence of burning on development of vegetation on clearcuts or in brushfields (Dyrness 1973, Gratkowski 1961 and 1965, Isaac 1940, Morris 1970, Steen 1966, Yerkes 1960). Few of the existing studies, however, concern cuttings in the Coast Ranges; and only one examines response to spraying and burning (Gratkowski 1961 and 1965). Knowledge of origin of vegetation following site preparation is important in developing silvicultural practices that minimize establishment of undesirable species. Origin of brush species after fire has been studied in chaparral types of California and southwestern Oregon (Gratkowski 1961 and 1974, Horton and Kraebel 1955, Sampson 1944, Stone and Juhren 1951) but is unknown for most coastal species.

Figure 1.--Fires in sprayed brush build up and spread rapidly and uniformly.

A field study was initiated during 1972 to determine the origin and development of vegetation after spraying and burning in the central Oregon Coast Ranges. This study measured changes in vegetation before and after spraying and burning and after application of herbicides to release planted Douglas-firs on one clearcut.

[1]Scientific names of species mentioned are tabulated at the end of the report.

METHODS

A 40-acre (16.19 ha) clearcut logged during late winter and early spring of 1972 near Cannibal Mountain (SE1/4 Sec. 21, T. 14 S., R. 10 W., Western Meridian) in the Waldport Ranger District of the Siuslaw National Forest, Oregon, was selected for study. About 86 percent of the volume removed was Douglas-fir, 10 percent was red alder, and 4 percent was western hemlock.

The cutting was aerially sprayed in late July with 2 pounds (2.24 kg/ha) acid equivalent (ae) of low volatile esters of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) in an oil-in-water emulsion carrier containing 0.5 gallon (4.7 l/ha) of diesel oil, 8 gallons (84 l/ha) of water, and 0.5 pound (0.56) kg/ha) of Vistick spray thickener per acre. The area was then broadcast burned in late September, 2 months after spraying, and planted with 2-0 Douglas-fir in February of 1973. An aerial spray containing 3 pounds (3.36 kg/ha) ae of low volatile esters of 2,4,5-T in 8.25 gallons (77.1 l/ha) of water per acre was applied in August of 1975, 3 years after burning, to release the plantation from competing vegetation. Rain, falling shortly after application of the release spray, reduced the effectiveness of the herbicide and resulted in a low degree of brush control.

An intermittent stream divided the cutting into north- and south-facing slopes. Five randomly located 100-foot (30.5-m) line intercepts were established on both slopes to estimate ground cover before burning (August 1972), 1 year after burning (July 1973), 3 years after burning and just before release spraying (June 1975), and 4 years after burning and 1 year after release spraying (August 1976). The before-burning sample was obtained about 2 weeks after spraying, before herbicide-induced wilting had occurred. Length of live crown intercept of each species, projected onto 2.5-foot (0.76-m) high sample lines, was measured to the nearest 0.1 foot (3 cm) and percentage cover calculated using a method described by Canfield (1941). Transects were oriented down the prevailing slope and located according to a systematic random survey using different starting points for each examination.

Numbers of original or resprouting stems and new seedlings of all brush species were counted on five 1-milacre (0.001-acre or 0.0004-ha) circular plots located at 20, 40, 60, 80, and 100 feet (6.1, 12.2, 24.4, 30.5 m) along each intercept before and 1 year after burning. Plant origin was determined by uprooting all stems in each 1-milacre sample. Seedlings were distinguished by the presence of an independent root system originating from the root crown and usually by the presence of cotyledons. Plants arising from sprouts had root systems arising from buried plant parts and did not have cotyledons.

RESULTS

Changes in ground cover before and after burning and release spraying are shown in table 1; cover changes for slash, herbs, shrubs, and trees are also shown in figure 2. Total cover and relative composition were similar on north and south aspects prior to burning, although shrub cover was slightly higher on the south slope. Logging disturbance alone would not have adequately prepared the site for planting.

Spraying and burning converted the predominant cover from logging slash and salmonberry to woodland groundsel. Herbaceous cover attained a maximum by the 3d year after burning while shrub cover continued to increase. By the 3d year, shrub cover exceeded preburn levels on both north and south slopes (fig. 3). This suggests that spraying and burning delay brush development about 3 years. In some instances, this may be adequate to allow large planting stock to outgrow competing vegetation on at least a portion of the cutting.

Table 1--*Ground cover before and after burning and after release spraying on a north and south aspect in the Oregon Coast Ranges*

Species	North aspect				South aspect			
	Before burn	1 year after burn	3 years after burn	4 years after burn, 1 year after release	Before burn	1 year after burn	3 years after burn	4 years after burn, 1 year after release
	Percent of total cover							
Trees:								
Douglas-fir	0	0.03	0.60	0.40	0	0.03	0.60	2.20
Shrubs:								
Salmonberry	15.40	9.10	29.40	31.60	21.50	4.70	26.80	19.20
Thimbleberry	.20	.20	2.70	.80	0	.80	1.70	2.30
Red huckleberry	.50	.10	.70	0	3.00	0	1.20	1.20
Red elderberry	.05	.01	1.00	.60	0	.02	.07	0
Vine maple	1.30	.10	.10	.10	.60	0	.40	0
Salal	.70	.20	0	0	5.30	1.10	1.80	7.00
Trailing blackberry	0	0	0	0	.20	.90	2.40	.20
Other Shrub	.50	0	.10	0	.60	.07	.30	.40
Total shrub	18.65	9.70	34.00	33.10	31.20	7.60	35.30	30.30
Herbs:								
Swordfern	5.50	3.20	7.80	5.80	3.90	.80	.90	1.00
Bracken fern	0	0	.80	0	.90	3.00	12.30	25.70
Woodland groundsel	1.40	22.70	.40	1.60	2.30	41.10	1.30	1.10
Grasses	0	.20	12.20	28.90	0	.40	13.40	25.80
Other herbs	.10	1.60	18.90	5.80	.30	1.70	20.40	23.20
Total herbs	7.40	28.70	41.90	42.10	7.40	47.50	48.50	76.80
Slash:	53.60	20.00	26.80	24.80	43.90	15.40	20.30	12.30
Total cover	79.60	58.40	103.30	100.40	82.50	70.50	104.70	121.60

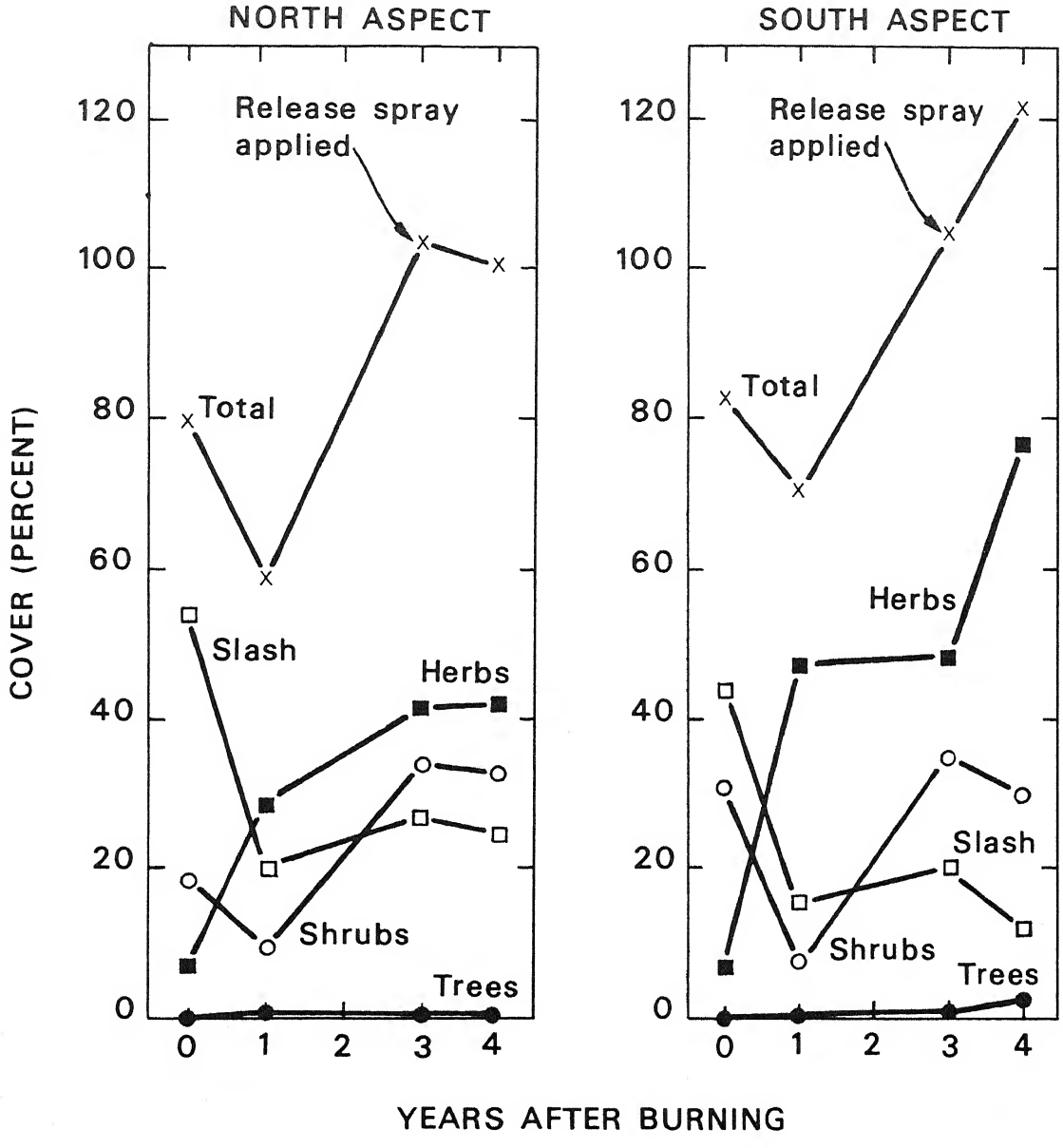

Figure 2.--Changes in ground cover before and after burning on a north and south aspect.

A

B

Figure 3.--Changes in vegetation on north (foreground) and south (background) aspects. A. Slash and salmonberry predominate after logging. B. Common groundsel predominates 1 year after burning. C. Salmonberry predominates 3 years after burning.

A release spray applied 3 years after burning seems to have retarded further development of the shrub component of the plant community despite the reduced effectiveness of the herbicide. Herbaceous cover on the south slope increased markedly following spraying, however. This increase was due to a doubling of bracken fern and grass cover between the third and fourth year after burning. Bracken fern and grasses are resistant to 2,4,5-T. Increases in grass cover also occurred on the north aspect after spraying but were balanced by losses in cover of other herbaceous species.

Before burning on the north aspect, 47 percent of all brush stems originated from new seedlings (table 2); on the south aspect, only 13 percent originated from seedlings. These seedlings were usually found on microsites disturbed by logging with partial or complete removal of the surface litter. Total number of seedlings before burning was lower on the south slope than on the north slope. Species composition, however, was similar except that trailing blackberry was found only on the south slope and thimbleberry on the north slope in this survey. Total number of original and resprouting stems and seedlings was 1.3 times greater on the north than on the south aspect.

After burning, 61 percent of all brush stems on the north and 50 percent on the south aspects originated from seedlings. Total brush density increased only slightly as a result of burning on the north but increased 3.5 times on the south aspect. Salmonberry was abundant on both aspects while thimbleberry was more common on the south slope. Salal, red elderberry, and trailing blackberry were found almost exclusively on the south slope after burning.

About 90 percent or more of all brush seedlings before and after burning on both aspects were salmonberry and thimbleberry. Germination of salmonberry seeds seemed to be little influenced by broadcast burning--there were about as many seedlings germinating after burning as there were before

Table 2--*Origin of brush species before and 1 year after burning on a north and south aspect in the Oregon Coast Ranges*

Species	North aspect				South aspect			
	Before burning		1 year after burning		Before burning		1 year after burning	
	Original stems	Seedlings	Original stems & sprouts	Seedlings	Original stems	Seedlings	Original stems & sprouts	Seedlings
	Number per acre							
Trees:								
Bitter cherry	0	0	0	40	0	0	0	480
Shrubs:								
Salmonberry	10,700	6,150	7,880	5,680	10,920	2,120	10,520	3,920
Thimbleberry	0	4,450	0	8,760	0	0	200	24,640
Red huckleberry	550	0	0	0	1,200	0	1,440	0
Red elderberry	0	650	0	1,640	0	40	0	2,240
Salal	250	0	640	0	2,840	0	15,960	0
Trailing blackberry	0	0	0	0	40	200	1,520	0
Other shrubs	1,300	0	1,640	0	600	0	1,520	0
Total	12,800	11,250	10,160	16,120	15,600	2,360	31,160	31,280

burning. In contrast, germination of thimbleberry seeds seemed to be stimulated by conditions created by burning; there were 7.5 times as many seedlings following burning as there were before burning. Red elderberry seeds also appeared to be influenced by burning; seedlings were found after, but not before, burning. Neither of these species, however, contributed significantly to vegetative cover 3 or 4 years after site preparation. The data and personal observations on other cuttings suggest that the predominant shrub cover develops from resprouting of species that were present at the time of logging. The numerous brush seedlings are largely eliminated by animal browsing, competition, or other causes. Thus, the original shrub understory, perhaps of almost identical genetic makeup, with a few minor additions tends to replace itself about 3 or 4 years after burning.

The proliferation of seedlings following broadcast burning may result from removal of inhibitors or exposure of mineral soil by the fire. A study of natural seed populations suggests that most brush seed germination occurs in soil rather than in the litter (table 3). Ten 1-foot-square samples of surface litter and underlying A soil horizon to a depth of 2 inches (5 cm) were collected from a thinned second-growth Douglas-fir stand near Lakeside, Oregon on November 1, 1972, after all natural seed fall had ceased. The understory consisted of dense salmonberry with scattered red huckleberry and red elderberry. Samples were either left unheated or heated in an oven for 230 minutes at 170°F. Maximum temperatures attained were 131°F (55°C) in the litter and 129°F (53.5°C) in the soil. Litter and soil samples were then placed in separate flats in a lath house at Roseburg, Oregon and allowed to overwinter. Emergence of all species was recorded on June 28, 1973, the summer after treatment.

The results show that either fewer brush seeds occur in the litter or conditions there are not conducive to germination. Ruth (1970) found large numbers of salmonberry seedlings arising from mineral soil after removal of litter by tractor scarification. This suggests that the underlying soil has a large seed population. In contrast to brush species, herbaceous species germinated primarily from the litter layer. Woodland groundsel, a prolific seed producer and the most common invading herbaceous species on the Cannibal Mountain clearcut, was found in the Lakeside sample in large numbers in both soil and litter. Heating to about 130°F had little effect on most species but may have reduced viability of woodland groundsel seeds.

Table 3--*Emergence of seedlings from litter and soil collected under a thinned Douglas-fir stand*

Treatment	Average number per 1 foot square flat by species					
	Salmon-berry	Thimble-berry	Elder-berry	Woodland groundsel	Western springbeauty	Grass species
nheated	0.4	0.4	0	32.4	0.2	0.8
eated to 131°F	.2	0	0	23.0	2.0	.2
eated	5.0	2.0	.2	16.0	.4	.4
ted to 129°F	3.0	2.4	.8	10.2	0	0

SILVICULTURAL IMPLICATIONS

This study suggests that resprouting of most understory brush species may reestablish the brush cover 3 to 4 years after logging, spraying, and burning in the Oregon Coast Ranges. If found to be more generally true, this rapid development suggests that burned units should be planted with large vigorous stock the first winter after burning to reduce or eliminate the need for release sprays. For preburn sprays, it is essential to use herbicides that produce a high degree of control of resprouting and then allow enough time between spraying and burning to permit translocation of the chemical to the roots in order to obtain maximum effect of the herbicide. Recent small-scale aerial spray tests suggest that a budbreak spray of 1/2 to 3/4 gallon per acre (4.7 to 7.0 liter/ha) of Tordon 155 in diesel oil followed by a late August or early September burn will reduce resprouting and the need for release sprays.

Even with good control of resprouting, some reestablishment of brush species can be expected from germination of existing seed in the soil. This will occur even in the absence of burning because logging disturbance alone is sufficient to expose suitable seed beds. Reinvasion from new seedlings will occur much more slowly than from resprouts originating from well-established root systems due to initially slower growth and high mortality of seedlings. Planted conifers probably have an advantage over small brush seedlings. If release spraying is necessary, the younger stems and less extensive root systems of seedling plants make them highly susceptible to herbicides.

This study suggests that good control of residual vegetation is essential. By minimizing disturbance and exposure of mineral soil, it may also be possible to reduce germination and establishment of new seedlings. Burning may increase the establishment of seedlings but may be necessary to reduce fire hazard or provide access for planting.

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APPENDIX I

Common and Scientific Names of Species Mentioned[1/]

Trees

Bitter cherry	*Prunus emarginata* Dougl.
Douglas-fir	*Pseudotsuga menziesii* (Mirb.) Franco
Red alder	*Alnus rubra* Bong.
Western hemlock	*Tsuga heterophylla* (Raf.) Sarg.

Shrubs

Red elderberry	*Sambucus racemosa* L. var. *arborescens* (T. & G.) Gray
Red huckleberry	*Vaccinium parvifolium* Smith
Salal	*Gaultheria shallon* Pursh
Salmonberry	*Rubus spectabilis* Pursh
Thimbleberry	*Rubus parviflorus* Nutt.
Trailing blackberry	*Rubus ursinus* Cham. & Schlecht.
Vine maple	*Acer circinatum* Pursh

Forbs

Bleeding heart	*Dicentra formosa* (Andr.) Walp.
Bracken fern	*Pteridium aquilinum* (L.) Kuhn var. *pubescens* Underw.
Swordfern	*Polystichum munitum* (Kaulf.) Presl
Western springbeauty	*Montia sibirica* (L.) How.
Woodland groundsel	*Senecio sylvaticus* L.

[1]Scientific and common names are those used in "Natural vegetation of Oregon and Washington" by Jerry F. Franklin and C. T. Dyrness. 1973. USDA For. Serv. Gen. Tech. Rep. PNW-8, 417 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

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